Introduction to Computer Graphics

Section 7 : http://bit.ly/section7_CG
Sheet 7 : http://bit.ly/sheet7_CG

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Question 1

What is the difference between interactive and non-interactive computer graphics program?
What are the components/libraries required to implement an OpenGL interactive computer program?

Answer 1

- **In** an interactive computer graphics program, the output of the program **changes** upon a **user input**.
- This input could be a **mouse click**, **mouse move**, **pen flicking** or a **keyboard** input as examples.

Note:
non-interactive computer graphics program output does not respond to user inputs **during its execution**.

Answer 1:

- To implement an interactive OpenGL computer graphics program, we need to use the **underlying operating system windows** and input-output components.
- The interaction with these components is system **dependent**.
  For example, the interaction with the **X-window on Unix/Linux** operating system is different from that with the **Microsoft windows**.
- **Hence,** a specific **window-system** API is required for each operating system to fully utilize its capabilities from OpenGL.
- A **basic set of** common **window-system functionalities** are implemented in a cross-platform library called GLUT.
- An OpenGL programmer can use GLUT library to implement the basic interaction with the underlying windowing and input/output system.
- GLUT is cross-platform on the function definitions and declaration level, but, of course, is system dependent on the binary-level.

Question 2:

Explain the difference between physical input devices and logical input devices. Give examples for each.

Answer 2:

Physical input device are the **devices** employed by the **user** to **input some data** to a computer program. They are usually **classified** according to the **type** of data they can enter as follows.

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- **Text input devices**: The keyboard is the primary text input device but other devices exist like character recognition systems and data files/streams

Answer 2:

Physical input device are the **devices** employed by the **user** to **input some data** to a computer program. They are usually **classified** according to the **type** of data they can enter as follows.

- **Pointing devices**: They are used to input location data. The primary example is the standard mouse. Other examples include trackball, data tablets, pens/stylus, joysticks, and space ball. A pointing device may be sub-classified according to the degree of freedom it allows as follows

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- **Pointing devices**:
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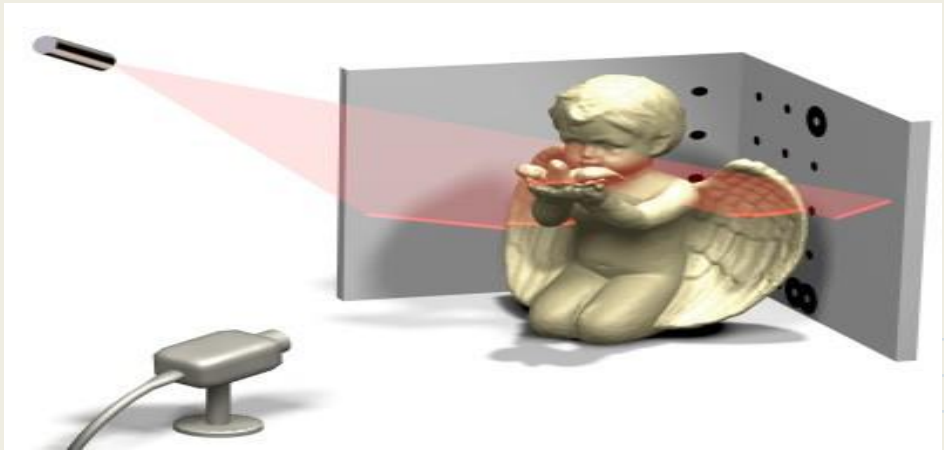
Physical input device are the **devices** employed by the **user** to **input some data** to a computer program. They are usually **classified** according to the **type** of data they can enter as follows.

- **Pointing devices**:
  - **Three degrees** of freedom like laser scanner that scan three dimensional objects and input their three dimensional data points



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  - **Two degrees** of freedom devices like the mouse and trackball
  - **Three degrees** of freedom like laser scanner that scan three dimensional objects and input their three dimensional data points

More than three degrees of freedom like the space ball the allow pointing in three independent directions plus twisting in three independent directions

Answer 2:

Logical input devices are the means of inputting data from the **application point of view**. These are the APIs and data input interface widgets. Some examples are scanf function in the c language, cin object in the C++ language, List boxes and menus in a windowing environment. They can subclassified according to the nature of the data they provide as follows:

- **String devices:** a software object or API that abstract physical text input devices such as cin and scanf
- **Location devices:** a software object or API that provide location specified by and physical pointing device. For example, any physical pointing device connected to a windows operating system gives a Mouse Click event when clicked.
    - Here the Mouse is used as a logical pointing device; the click may be originated from a stylus.

Answer 2

- **Pick devices:** are used for picking an object from several
- Choice devices: are used to select one options from several. List boxes are familiar examples.
- **Valuators devices:** are used to input values. Numerical Up/Down controls for changing values like dates and times are some examples.
- **Stoke devices:** Are used to input array of locations are a result of moving a physical input device such as a mouse or a pen.

Question 3 :

The manner by which input devices provide input to an application program can be described in terms of two entities: a measure process and a device trigger.

A. Explain what is the measure process and what the trigger may be
B. What are the three distinct modes by which an application can get a measured value from an input device

Answer 3 :

The measure process is the process the device does to **prepare** the **data** to the applications. For example,

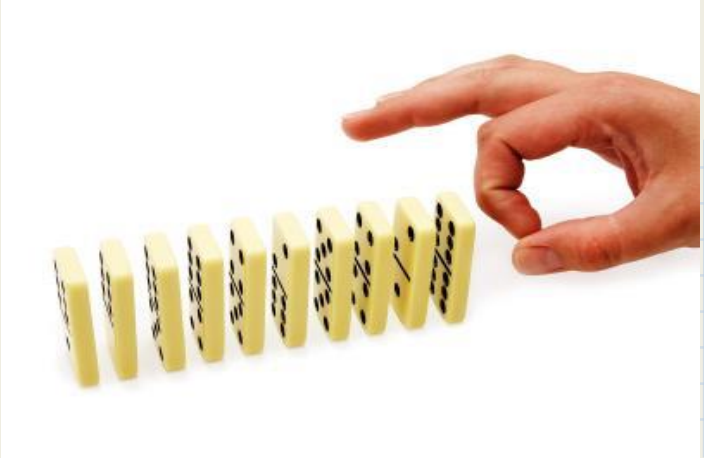
- the measure process for a keyboard is the process of stocking the input character codes in a keyboard buffer to be ready for the application.
- The measure process of a mouse is the continuous conversion of locations based on the mouse ball movement.

Answer 3 :

The trigger is an action that determines the **start** or **end** of a measure process or the moment at which the current data obtained from the measure process should be handed to the application.

For example:

- the trigger for a text input could be pressing the Enter key. For the mouse
- the trigger could be a click.



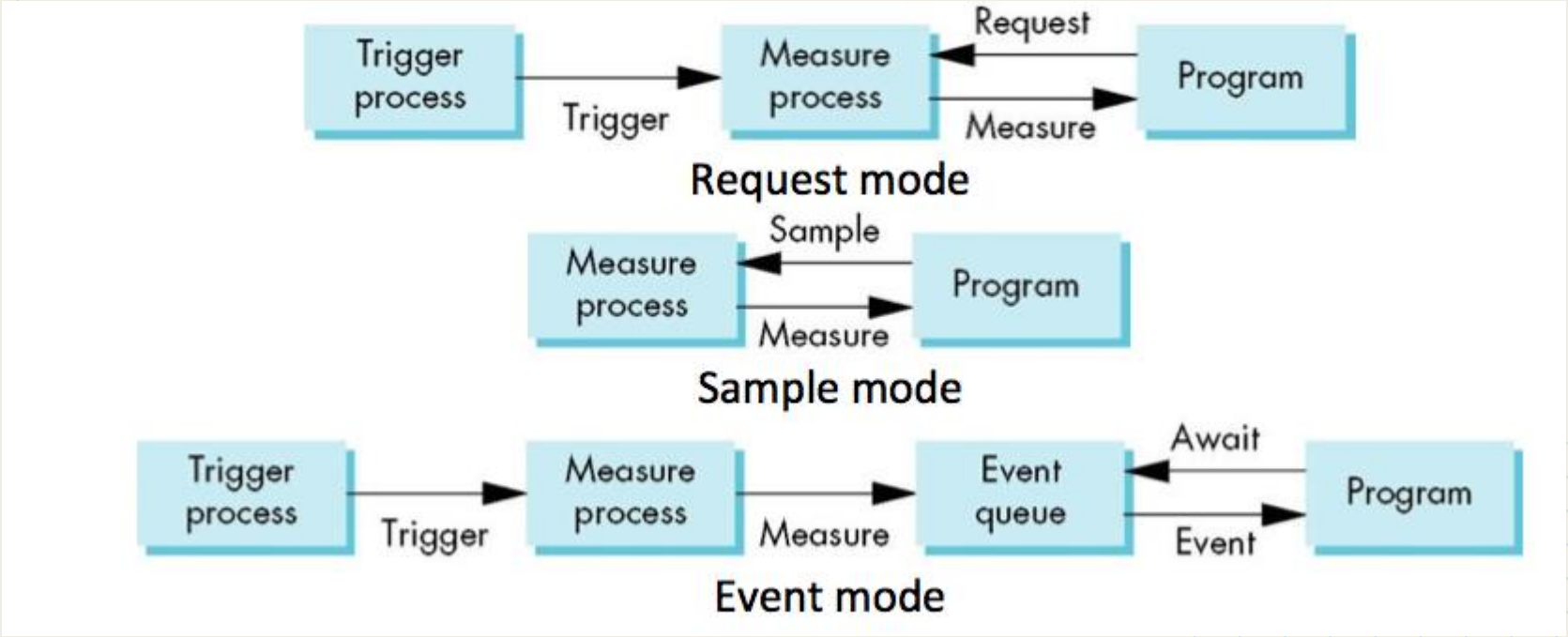
Question 4:

The three distinct modes are

- **Request mode:** The application requests input. The measure process starts until the trigger is activated. The input is handed to the application. The keyboard input is an example.
- **Sample mode:** The measure process in continuous. When the application need, it can take a sample (read the current measure value). The mouse move then click is an example.
- **Event mode:** The trigger causes the input mechanism fire an event in providing the measure values at the triggering moment. It’s up to the application program to handle or ignore the event

Question 4:

The following three figure explain the three modes



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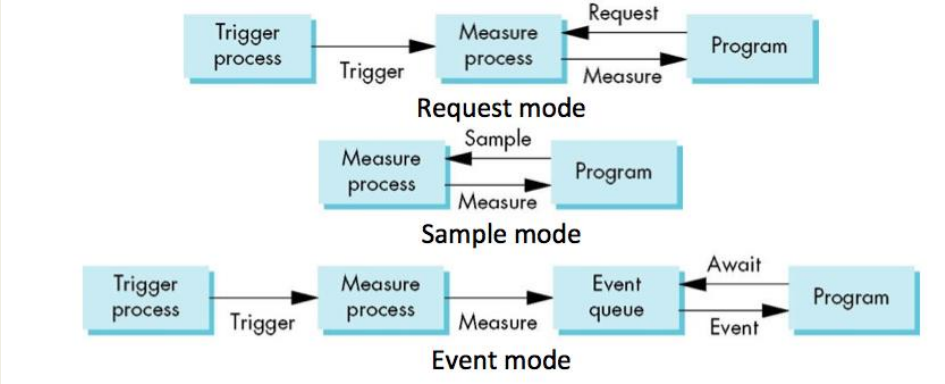

This can be, and usually is, arranged in a Client-Server relationship. The input data of a given physical input device is available as an input service available to all clients which are the application programs and other components on the system or on another system connected through a network.

Question 5:

Explain the work done by each of the following OpenGL functions and when they should be used

A. **glPushAttrib(GL_ALL_ATTRIB_BITS);**
B. **glPushMatrix();**
C. **glpopAttrib();**
D. **glPopMatrix();**

Answer 5:

- **glPushAttrib(GL_ALL_ATTRIB_BITS):**
  This function call makes all the contents of the attribute bits to be pushed on the stack. These attribute bits maintain the current value of the **state machine** such as the current drawing color and clear color.
- **glPushMatrix():**
  this function call makes all the contents of the transformation and viewing matrices are pushed on the stack. These matrices specify the current transformation that are applied to the vertices before projected and how they are projected.
- **glPopAttrib():**
  Reloads the attribute bits, hence the corresponding state machine, from the stack.
- **glPopMatrix():**
  Reloads the transformation and viewing matrices from the stack

Question 6:

Write an OpenGL program to display the word Computer Graphics one time in each of the following fonts

A. GLUT_STROKE_MONO_ROMAN
B. GLUT_STROKE_MONO_ROMAN
C. GLUT_BITMAP_8_13

Answer 6:

http://pastebin.com/K5DS32gC

Thanks